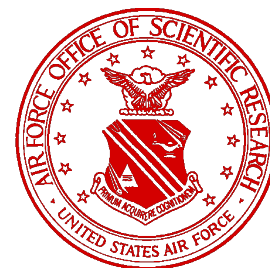




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The Asia Science Letter is a bi-monthly publication of the Asian Office of Aerospace Research and Development (AOARD), Detachment 2 of the US Air Force Office of Scientific Research (AFOSR), the basic research manager of the Air Force Research Laboratory (AFRL). Its purpose is to inform the Air Force S&T community on the research and development activities in Asia and Pacific Rim countries including India and Australia. The assessments in this periodical are solely those of the authors and do not necessarily reflect official US Government, US Air Force, or AFOSR positions.

Highlights

Dr. Louis Metzger, Air Force Chief Scientist, and Col. Don Eebschloe, Military Assistant, visited Yokota Air Base on 30 March, accompanied by Col. Jan Cerveny (AFOSR), Mr. John McNamara (AFRL/IF), and others. This was a part of Dr. Metzger's effort to understand the command and control related activities in the pacific region. Representatives from the Fifth Air Force, US Force Japan and AOARD briefed on the related topics.

In coordination with NSF and DARPA, Dr. Brett Pokines is organizing a study mission for Air Force Scientists and Engineers to assess micro/nano technology in Japan. This study mission is being planned for mid-August in conjunction with "Power MEMS Workshop" at Tohoku University, Sendai Japan. Asian Initiative funds (announced in the last ASL issue) will cover the travel expenses of AF participants.

Ms. Joanne Maurice participated in International Technology Research Initiative (ITRI) Panel on Asian Electronics Manufacturing Update (AEMU), 8-15 April. ITRI is sponsored by multiple US Government Agencies, including NSF and DARPA. This study panel was under the guidance of the US Department of Commerce. They visited research organizations in academia, industry and government in China (Hong Kong, Shenzhen, Shanghai, and Beijing). Ms. Maurice's report will appear in the next issue of ASL.

Of special interest in this issue:

- In Features, a short commentary on the status of the aerospace industry in Japan.
- Fire-fighting technology in Japan. Site visit reports in the Human Systems section describe innovative application of robotics in fire fighting, search, and rescue operations; use of virtual reality for training; and hands-free man-machine interface.

Koto White

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Features

Aerospace Industry in Japan

In Japan, the aerospace industry is relatively small compared to the automotive and electronic industries. In 1998, the Japanese aerospace industry had about 33,000 employees generating over \$13.0 billion in revenue - about one tenth that of US. These figures include the space industry with \$3.0 billion in revenues and 8,300 employees. A large portion of these aerospace sales are from subcontracting efforts to manufacture component-level parts (airframes, solar arrays, stabilizers, ...etc) for the major US and European companies.

Typically, the aerospace business represents only about 15% of total corporate revenues. Upper management perceives this as low priority and gave inadequate support for the aerospace division. Management tends to focus on their core revenue generating businesses such as the industrial machinery, shipbuilding, auto, and electronics. However, Japan has launched more than 30 satellites (commercial and scientific) since 1970, currently behind only the US, Russia, and France in launching satellites. The Boeing Company and Mitsubishi Heavy Industries have announced a partnership on a new low-cost upper stage hydrogen engine (MB-XX) for the Delta IV and other launch vehicles. The Mitsubishi Electric Corporation (MELCO) is the largest satellite manufacturer in Japan with annual sales of about \$1.0 billion. To compete and streamline their space business, the Nippon Electric Corporation and Toshiba Corporation recently announced consolidation of their space divisions and together they generate about \$600 million in sales.

Even with a mediocre management support and a recent series of launch vehicle and satellite failures, Japanese companies are poised to compete for the aerospace market worldwide. (Kim)

Engineers and Scientists Exchange Program (ESEP)

In early March, representatives from AFOSR, EOARD, and AOARD visited the Ernst Mach Institute in Freiburg and Efringen-Kirchen, Germany, and the Institute of St. Louise, France, and met with the seven US Air Force ESEP participants. Briefings and laboratory visits highlighted the institutes' unique capabilities in ballistics,

detonation physics, aerodynamics, and materials mechanics. Dr. John Corley, Exchange Engineer from AFRL/MN, did an excellent job in organizing and coordinating the meeting.

Ms. Kathleen Zyga, Exchange Engineer from AFRL/IF, is currently the only ESEP participant from the Asian Pacific region. She is doing research at the Defense Science and Technology Organization in Salisbury, Australia. She has moved to Information Management and Fusion Group, and her research area has evolved into Neural Network for Logo Recognition and Automatic Pattern Recognition. (White)

Aerospace

Conference: The 10th Japan International Aerospace Exhibition (Tokyo Aerospace 2000), Tokyo Big Site, Japan; 24 March 00. Organized by the Society of Japanese Aerospace companies, this exhibition displayed current and future aerospace related hardware and software from about 300 aerospace companies representing 25 countries and Japanese R&D centers. Japan's Science and Technology Agency and Ministry of Post & Telecommunications have jointly funded the development of a high altitude self-propelled dirigible system for future communication & broadcasting, disaster monitoring, and Earth observation. This solar-powered system called "Stratospheric Platform" is an unmanned zeppelin-like airship maintained at an altitude of 20 km. The multiple stratospheric platforms will not only permit observations of objects from many different angles, it may also offer low-cost broadband wireless communication systems in the microwave or millimeter-wave band. Major technical challenges include the development of lightweight & high-intensity membrane materials, reliable flight controls for recovery and launch, and efficient lightweight solar and regenerative fuel cells. (Kim)

Research Contract: Bonded Repair to Cylindrically Curved Shell Structures, Prof. Liyong Tong, Department of Aeronautical Engineering, University of Sydney; March 2000. The overall objective of this research is to develop a new theoretical framework for modeling adhesive joints and repairs to curved surfaces under combined mechanical and thermal loading conditions. Prof. Tong will investigate the effect of non-uniform adhesive thickness and nonlinear adhesive properties on the interlaminar stresses in adhesive. The model of composite tubular specimen bonded with a

composite patch will be validated by the experimental results. Current analysis methods and empirical databases for composite bonded joint design and for composite patch repair designs are limited to flat plate and/or flat laminate geometry. This research may determine the effect of curvature on the performance and durability of composite bonded joints and bonded composite repairs. An understanding of the influence of curvature on the interlaminar stress, that are believed to govern the lifetime performance of bonded joints, will ultimately lead to the development of design tools for more reliable structural repairs.

In task one, Prof. Tong was able to derive a variational formulation that was used to develop the eight-node serendipity shell element for the adhesive element. Adhesive shell element is a curved lamina in 3-dimensional space and each node has 5-degrees of freedom (3 translation displacements and 2 in-plane rotations). This element has been used to model both parent shell structures and the bonded patches. Nonlinear adhesive behavior will be included in this formulation to accurately predict stresses in the adhesive layer. Dr. Greg Schoeppner at AFRL/MLBC is fabricating the experimental specimens that will be subjected to internal pressure and/or a thermal loading to measure strain levels. (Kim)

Site Visit: Department of Materials Science, Tokai University, Hiratsuka, Japan; 26 November 99. Prof. Yoshitake Nishi reported for the first time, the reversible shape memory effect (thermoelastic phase transformation) of bi-ceramic glass. The shape memory materials are a unique class of alloys such as nickel-titanium (Ni-Ti) that are able to "remember" their shape and return to that original shape even after being bent. All shape memory alloys (SMA) exhibit two very distinct crystal structures or phases depending on the temperature and the amount of stress being applied. These phases are known as martensite, exists at lower temperatures, and austenite, exists at higher temperatures. This property has led to many uses for shape memory alloys ranging from coffee makers to medical devices to controlling unwanted structural and noise vibrations in aerospace applications. However, these alloys cannot be used in very high temperature environments such as nuclear power reactors, jet engines, and thrust chambers.

The reversible shape memory effect (SME) of borosilicate-sodium bi-ceramic glass can operate at high temperatures (>400 °C) and exhibits resistance to corrosion. The bi-ceramic glass is produced combining (diffusing) the borosilicate (Pyrex) and sodium glasses

above their glass transition temperature (T_g). The large strain change can be found at the temperature range of 620 ± 50 °K on heating and cooling. Maximum shape change of up to 19% can be achieved and transparent bi-ceramic glass can also be fabricated. (Kim)

Site Visit: The Department of Materials Engineering, Monash University, Victoria, Australia; January 2000. Materials engineering is concerned with the relationship of structure to properties, processing, and the way in which these control material use in engineering applications. The Department of Materials Engineering at Monash University, drawing upon its extensive resources, hosts the Centre for Advanced Materials Technology (CAMT), and is a key member of and provides research to Australia's nearby Cooperative Research Center for Polymers (CRC-P). In addition, the Department hosts the Engineering Microscopy and Microanalysis Facility for the study of properties (mechanical, optical, electromagnetic, and chemical). CAMT, established in 1989 as an Australian National Key Centre for advanced materials research technology, offers a variety of R&D services and provides a platform for industrial collaborative R&D for the Department.

The Department has a mix of research in metals, ceramics, and polymers and a focus on the fundamental aspects of phase equilibria and the role of structure in determining mechanical, electrical and optical, and degradation properties. Developing research areas include:

- composite materials,
- fuel cell technology,
- telecommunication materials,
- deterioration and
- control of properties.

In ceramics, research initiatives include the thermal stability and ion conduction in cubic zirconia. Stabilized zirconia alloys have emerged as an electrolyte candidate in new-generation high-temperature ceramic fuel cells. The Department is a leader in polymer chemistry and engineering. Materials of investigation are plastics and polymer-ceramic composites, with extensive expertise in conducting polymer blends (the ionic conductivity and diffusion in polymer-in-molten-salt electrolytes), polyurethane's and foams (including sol-gels). Senior faculty members Drs. Douglas MacFarlane and Maria Forsyth, known for novel electrolytes with properties suitable for electrochemical applications, are active in new energy technologies such as electroactive materials for high-density lithium batteries, polymer membrane fuel cells and sensors, and supercapacitors. Lithium-ion batteries, in particular, offer the desired performance requirements for spacecraft batteries. In addition to

significant savings on mass and volume, they are superior in the essential low-temperature performance requirements for spacecraft applications. Dr. Forsyth is also active in corrosion engineering and materials durability. Her work includes the use of thin polymer coatings for corrosion protection of steels. The Department has 13 academic staff and approximately 200 students. It will host the upcoming 7th International Symposium on Polymer Electrolytes (ISPE7) at the CAMT. (Maurice)

Micro and Nano Systems

Site Visit: National Agriculture Research Center, Tsukuba, Japan; 17 Jan 00. Microsystem and nanosystem technology (MST & NST) offers new tools for agricultural development. Researchers such as Mechanization Laboratory leader Mr. Ken Taniwaki at the National Agricultural Research Center (NARC) are applying MST & NST to agricultural production. Researchers from the National Institute of Sericulture and Entomological Science (NISES) and the National Food Research Institute (NFRI) are also conducting microsystem research at NARC. The goal of the NARC research includes developing micro-technologies to control insects and weeds, assist crop harvest, and increase crop quality. Specifically NARC researchers are developing hybrid bio-mechanical systems to combat insects, investigating micro-dynamics, engineering precision harvesting systems, and producing low-cost sensors.

Mitigating the damage insects, disease, and weeds inflict on the production of agricultural products is accomplished through the use of chemical treatments, genetically altered crops, and conventional farming techniques. Pesticides and herbicides were the agriculture industry's original commercial solution to combat weeds and insects. Farming solutions based on chemicals, while effective, have caused significant environmental problems. Mishandling of agricultural chemicals has caused billions of dollars in health and property damage. The dangers of chemical farm products partially motivated researchers to develop alternative biotechnology agricultural solutions. Genetically altered seed, first introduced in 1996, may have a combination of benefits such as resistance to herbicide and a natural defense against insects. The molecularbiology approach has demonstrated a reduction in the need to use chemical treatments and the increase of crop yields. The downside of this approach is the possibility that genetically altered agricultural products will pass their antibiotic resistance to livestock and

humans, and their herbicide resistance to weeds. Traditional farming techniques such as crop rotation are effective in combating some insect damage but like pesticides can be overcome by metabolic, behavioral, and morphological insect adaptations. The ultimate solution to control weeds and insects is a low cost, adaptable mechanism that can be safely removed from the food chain and environment. Microsystems may offer alternative agricultural production method solutions.

Hybrid bio-mechanical systems developed by Dr. Yoshihiko Kuwana (NISES) offer the opportunity to monitor and study insect behavior as well as create new types of environmental protection systems. An FM radiotelemetry implant system .4g in weight with a maximum dimension of 12 mm has been demonstrated to study the free flight characteristics of the sweet potato hornworm. The system senses and transmits flight muscle electrical potentials of the insect during flight for 30 minutes. This recorded sensor information is being applied to the development of mechanical micro-flying systems. Other bio-mechanical system research includes the integration of a male silkworm moth's antennae into a mechanical system. The result is a hybrid sensor over 100 times more sensitive than conventional mechanical sensors. It is able to track insects or detect faint chemical signatures.

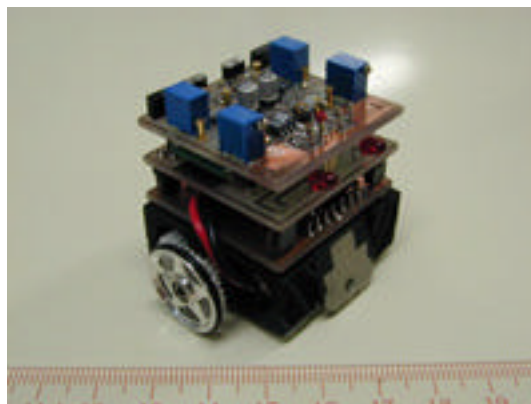


Figure 1. Hybrid Chemical Sensor.

Dr. Yukio Magariyama (NFRI), with his collaborator Dr. Kudo of Toin University, is studying the characteristics of micro-dynamics of swimming bacteria at NARC. Methods to observe flagellar rotation have been developed. These observation techniques have yielded further insight into the unexpected phenomenon of bacteria swimming faster in high viscosity fluids. The flagellar motor dynamics are studied in relation to bacteria speed and fluid viscosity. Analysis of this phenomenon could yield insight into methods to design small fluidic systems or controlling bacteria motility.

A special agricultural issue Japan is facing is the reduction and aging of farm worker population. In the last forty years the farm population has shrunk by 9 million people to a current level of approximately 3 million. Over 40% of current farm workers are sixty-five or older. Increasing farm mechanization is a possible solution to the problem of replacing these workers. Some tasks require a delicate touch to preserve produce quality, for example harvesting peaches. Microsensors incorporated into robotic arms are a solution path being examined at NARC. The goal is to mimic the agility of the human hand using micro-fabricated sensors.

There are two ways to increase the value of a harvest; increase total production and increase crop quality. Japan has one of the highest agricultural production costs in the world. Maximizing output and quality are both Japanese goals to increase their competitive ability in the agricultural market. Sensors to monitor crop conditions may lead to an improved harvest and product. Crop sensors developed by Dr. Celine Annarelli and Mr. Kazuto Shigeta could assist farmers in determining when chemical treatments are necessary, and how to modify soil or environmental conditions to improve crop quality. NARC is developing a soft-lithography method to fabricate low cost environmental sensors. The technology is based on the use of Serum Albumin to form regular crystal patterns. These stable structures are 10 μm wide, 20-30 μm tall, able to remain uniform up to temperatures of 80 degrees C, and have been shown to experience resistance changes as the result of light variations. The crystal structures can also be chemically modified to form molecular cages capable of holding a chemically sensitive molecule. The ultimate goal is to construct a uniform cage structure holding molecules sensitive to specific chemicals. Structural resistance changes could then be used to monitor field environment conditions. (Pokines)

Site Visit: The Synchrotron Radiation Research Center, Hsinchu Science-based Industrial Park, Hsinchu, Taiwan; 17 Feb 00. Taiwan's single synchrotron radiation source is located in Hsinchu at the Synchrotron Radiation Research Center. This national laboratory which went online in 1993 has approximately 172 in-house researchers. A total of over 400 researchers utilize the source through cooperative programs with industrial, academic and other government institutions. The facility is expanding with a projected increase of six synchrotron radiation (SR) beamlines, bringing the total number of beamlines to twenty in the spring of 2000.

One soft x-ray bending magnet beamline at wavelengths of between .3 nm and .4 nm is dedicated to high-aspect-ratio-micro-structure (HARMST) fabrication methods based on the German developed *lithographie galvanofornung abformung* or LIGA process. Taiwan is distinguished along with mainland China (3 SR sources), Korea (1 SR source), India (2 SR sources) and Japan (14SR sources) as possessing SR sources in Asia. LIGA type fabrication research using SR is being performed in Japan, China, Korea, and Taiwan.

Dr. Yoa Cheng has led the LIGA fabrication effort at SRRC since he initiated the work in 1996. Dr. Cheng's research group has developed a HARMST process that yields polymethylmethacrylate (PMMA) or electroplated Ni structures up to 2 mm tall with feature resolution of 2 μm . Figure 1 details a SRRC LIGA fabricated structure. This 2 mm height represents the maximum height achieved in a LIGA process. The structures are realized through a unique process incorporating a low-cost mask and multiple development and dosage accumulation. The low-cost mask (one-tenth the cost of comparable SR masks) is realized through the use of ultra violet-lithography. Traditional LIGA processes realize feature resolution in the submicron (.5 μm) range, and typically can achieve heights of 500 μm .



Figure 1. Spinnerets Formed Using LIGA

HARMST research at SRRC is focused on three areas;

- the development of micro-fiber spinnerets,
- millimeter wave klystrons and
- low-cost gyroscopes.

Taiwan is a leading producer of synthetic fibers. A critical synthetic fiber fabrication component is the spinneret. Conventional spinnerets are formed using electrodischarge-machining (EDM). Typically EDM can produce structures 300 μm tall with features 100 μm in size with a tolerance of .1 μm . Machining of spinnerets using EDM is an expensive and highly specialized process yielding a limited range of dimensions and therefore fabric

shapes. The SRRC LIGA process offers the opportunity to create complex mass-produced optimized spinneret shapes and a new generation of synthetic fiber shapes. The unique LIGA process at SRRC has also resulted in a joint project with Stanford University in the U.S. to develop a high power millimeter wave source. The predicted performance parameters for these tabletop high-energy sources are 100 kW peak power and 1 kW average power at 95 GHz. A low-cost gyroscope is also under development at the SRRC. The advantage of this design is that it requires only two masks for fabrication resulting in a low cost two-degree-of-freedom sensor. (Pokines)

Human Systems

Window-on-Science: Koo-Hyoung Lee, Ph.D., Chief Scientist, LGE Corporate Design Center, visits AFRL Human Effectiveness Directorate; 15 February 2000.

Dr. Lee visited AFRL/HE and presented a briefing on "Sensibility Ergonomics and Sensible Interface". Discussions following the briefing included cognitive process, training, and sensible interfaces. (Lyons)

Conference: The 24th Energy and Environment Exhibition (ENEX 2000), Tokyo Big Sight; 16-18 February 2000. The exhibition had a great variety exhibits ranging from practical applications to science such as MITI's New Energy Development Organization's (NEDO) latest research. The many exhibits on energy conservation and alternate sources of energy reflect Japan's continuing concern with energy issues. A particularly interesting exhibit was Nichia's LED traffic lights (very interesting because Nichia although a small company was the first able to make a blue/green LED). Also on exhibit were several natural gas and electric powered cars and trucks including Nissan's Hypermini electric car. (Lyons)

News: Firefighting Research in Asia

Dr. Juan Vitali, Team Leader, Fire Research Group, of AFRL/MLQ visited Japan to assess fire-fighting technologies being developed. He also addressed the use of Trifluoro Methyl Iodide (CF₃I) as a Halon 1301 replacement for fuel tank inertion applications and solutions to recycling existing stocks of Halon 1301. During his visit to Japan from 13 -20 January, he visited the National Research Institute of Fire and Disaster, the Tokyo Metropolitan Fire Department and AOARD.

Site Visit: Tokyo Metropolitan Fire Department, Headquarters, Fire Equipment Section, Tokyo, Japan; 18 January 2000. The Tokyo Fire Department has developed a line of robots for several specific applications.

1. Rainbow Five: Unmanned nozzle vehicle for fighting high intensity fires such as major oil fires. Sensors include ultrasound. Operator displays include 4 television cameras one of which is 3D (the operator uses a 3D Head mounted display). This robot has been used operationally with good results.
2. Jet Fighter: Small vehicle for fighting fire in enclosed areas such as tunnels. Sensors include T.V cameras, ultrasound, temperature, and gas sensors.
3. Fire Search: Stair climbing robot with multiple sensors including thermal vision, two color cameras, microphone, thermometer, and gas concentration measure
4. Underwater search and rescue robot: Sensors include sonar and underwater cameras. This robot has been deployed in real underwater search operations including river floods and off-shore earthquakes/tidal waves.
5. Wall Climber.
6. Robocue: Includes multi-articulated manipulator arms able to retrieve human casualties. Sensors include TV cameras, infrared camera, ultrasonic sensor, and "feeler" obstacle sensors, combustible gas, and temperature sensors. The robot's hands are controlled by the operators hands at the control panel with tactile feedback.

This is a remarkable development effort by a city Fire Department. Practically the robots have so far proven useful only in special situations and need continued development.

Site Visit: The Tokyo Fire Department Fire Science Laboratories, Tokyo, Japan; 18 January 2000. With a staff of 53, this laboratory conducts research over a broad spectrum of fire science and technology including fire behavior, smoke, fire starting mechanisms and combustion phenomenon, fire extinguisher efficiency, hazardous materials, protective equipment, escape, and rescue equipment, firefighter physiology, and disaster psychology. Among the many interesting technologies being developed were:

- (1) an active infrared imaging system for use in a smoke filled environment was demonstrated using an un-cooled array.

- (2) a data communication system connecting individual firefighter personal alarm devices with the monitor at the incident command post which sets off an alarm in the case of a motionless firefighter.

Site Visit: The Tokyo Fire Department Fire Academy, Tokyo, Japan; 18 January 2000. Several interesting training technologies were demonstrated ranging from building mock-ups (Hollywood-like sets) to virtual reality. Realistic training was being conducted with realistic buildings and a reconstructed subway station (actual fire in some rooms). Virtual reality applications in firefighter training were being used to train decision making and Command and Control. The Tokyo Metropolitan Fire Department's Fire Academy has developed NEC training software for commanders' training. This training program has also been adopted by other Japanese cities.

Site Visit: National Research Institute of Fire and Disaster, Ministry of Home Affairs, Tokyo, Japan; 17 January 2000. The full time staff of 51 is augmented by many visiting scientists. The current budget is approximately \$10 million per year. Plans include commercial contracts for research to be implemented over the next 5-10 years. Research Areas include

- the mechanisms of combustion,
- suppressing fires - combustion inhibition mechanisms
- technologies to assist firefighters,
- safety in the chemical industry,
- fire safety in the community, and
- disaster response.

Among the many interesting technologies demonstrated were a firefighter "hands-free" personal communication system (digital, portable, wireless) which used a 2 GHz relay system (Japanese PHS Handy-phone technology). Auditory input was via bone conduction allowing the ears to remain uncovered and throat microphone. The flame retarding/extinguishing effects of various fire suppressants including Halons and Halon replacements were being studied.

Site Visit: F-Tech Inc., Tokyo, Japan; 17 January 2000. F-Tech is a manufacturer of fluoro chemicals including 2,2,2-Trifluoroethanol, 1-Chloro-2,2,2-trifluoroethane, HFC-232, Organic Intermediates for electronics and pharmaceuticals, and specialty polymers. F-Tech is the world's largest manufacturer of Trifluoroethanol.

Dr. Vitali briefed F-Tech on USAF Test & Evaluation results of using CF3I as a fuel tank inertant for the F16 fuel tank. A discussion was held on potential routes of synthesis and on the potential for recycling existing stocks of Halon 1301 into non-ozone-depleting and usable CF3I. The potential market for this application is in the order of 100,000 pounds per year. Once conversion of 1301 stock is accomplished, current methods of iodination could still be used. The USAF and other current world users of Halon 1301 could benefit from using this technology and from reducing environmental stratospheric ozone impact of emissions. (Lyons)

Upcoming Conferences In Asia

These upcoming conferences may be of interest to you. Contact us for more details or check our homepage at <http://www.nmjc.org/aoard/> Conferences in **Bold Face** are AFOSR/AOARD Sponsored.

| Date | Name | Place |
|----------------------|--|---|
| May 21-26, 00 | 2000 IEEE 6 th International Conference of Properties & Applications of Dielectric Materials | Xi'an, China |
| May 22-25, 00 | Fourth International Commission on Non-ionizing Radiation Protection (ICNIRP) Workshop | Kyoto, Japan |
| May 23-26, 00 | Advanced Underwater Technologies for the 21 st Century | Tokyo, Japan |
| May 30-Jun 15, 00 | International Conference on Role of Mesomechanics for Development of S&T Mini-Symposia on Use of Intelligent Material Computational Mechanics Composite Technologies | Xi'an, Beijing, Dalian, Shanghai, China |
| May 30-31, 00 | 17 th Sensor Micromachine and Applied Systems | Kawasaki, Japan |
| May 30-Jun 1, 00 | 22 nd International Symposium on Space Technology and Science | Morioka, Japan |
| May 31-Jun 2, 00 | SEMICON Kansai 2000 | Osaka, Japan |
| Jun 1-2, 00 | International Symposium on Platform for Designing High Functional Material | Nagoya, Japan |
| Jun 5-9, 00 | The 10 th International Conference on Metal Organic Vapor Phase Epitaxy (ICMOVPE-X) | Hokkaido, Japan |
| Jun 7-8, 00 | 3 rd and 4 th Generation Mobile Technology | Kyoto, Japan |
| Jun 14-16, 00 | The First International Symposium on Laser Precision Microfabrication (LPM2000) | Saitama, Japan |
| Jun 19-21, 00 | International Conference on Sensors and Control Techniques | Wuhan, China |
| Jun 20-23, 00 | Visual Communications and Image Processing 2000 | Perth, Australia |
| Jun 25-28, 00 | The XIII Congress of International Society of Electrophysiology and Kinesiology (ISEK2000) | Sapporo, Japan |
| Jun 25-29, 00 | XI International Conference on Photoacoustic and Photothermal Phenomena Kyoto 2000 | Kyoto, Japan |
| Jun 25-30, 00 | 13th International Conference on High-Power Particle Beams | Niigata, Japan |
| Jun 26-29, 00 | Australian Conference on Optical Fibre Technology (ACOFT). Workshop on Broadband Networks. Workshop on Nonlinear Waveguiding | Australian National University, Canberra, Australia |
| Jun 26-30, 00 | 7 th Asia Pacific Electron Microscopy Conference | Singapore |
| Jun 29-30, 00 | International Workshop on Femtosecond Technology (FST 2000) | Tsukuba, Japan |
| Jul 2-6, 00 | 9th US-Japan Conference on Composite Materials | Shizuoka, Japan |
| Jul 9-13, 00 | 2000 International Symposium on Environmental Biotechnology | Kyoto, Japan |
| Jul 9-14, 00 | 22nd International Symposium on Rarefied Gas Dynamics (RGD22) | Sydney, Australia |
| Jul 11-13, 00 | 2000 International Microprocesses & Nanotechnology Conference (MNC2000) | Tokyo, Japan |
| Jul 11-14, 00 | Fifth Optoelectronics and Communications Conference (OECC2000) | Chiba, Japan |
| Jul 12-14, 00 | The International Workshop on ActiveMatrix Liquid-Crystal Displays-TFT Technologies and Related Materials (AM-LCD 2000) | Tokyo, Japan |
| Jul 24-28, 00 | International Liquid Crystal Conference (ILCC 2000) | Sendai, Japan |
| Jul 24-28, 00 | CF3I Seminar | Newcastle, Australia |
| Jul 26-28, 00 | Photonic Taiwan 2000 | Taipei, Taiwan |
| Aug 6-11, 00 | 7th International Symposium on Polymer Electrolytes (ISPE7) | Queensland, Australia |
| Aug 14-18, 00 | International Symposium on Applied Mathematics | Dalian, China |
| Aug 16-18, 00 | 4th International Conference on Fracture and Strength of Solids | Pohang, Korea |
| Aug 16-19, 00 | Aviation Medical Society of Australia and New Zealand | Broome, Australia |
| Aug 18, 00 | Internal Symposium on Science Exchange Between Academia-PowerMEMS | Sendai, Japan |
| Aug 18-20, 00 | 2nd Asian-Australasian Conference on Composite Materials (ACCM-2000) | Kyongju, Korea |
| Aug 20-23, 00 | Topical Workshop in Heterostructure Microelectronics (TWHM'00) | Kyoto, Japan |

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|-------------------------|--|------------------------|
| Aug 22-24, 00 | 3rd Composite Durability Workshop (CDW 2000) | Kanazawa, Japan |
| Aug 27-Sep 1, 00 | 26 th International Congress on Occupational Health | Singapore |
| Aug 28-31, 00 | 2000 International Conference on Solid State Devices and Materials (SSDM 2000) | Sendai, Japan |
| Aug 29-Sep 1, 00 | The 1 st Asian Conference on Crystal Growth and Crystal Technology | Sendai, Japan |
| Sep 5-7, 00 | The 1 st International Display Manufacturing Conference and Exhibition | Seoul, Korea |
| Sep 5-8, 00 | International Symposium on Optical Memory 2000 (ISOM 2000) | Hokkaido, Japan |
| Sep 10-14, 00 | 16 th International Workshop on Rare-Earth Magnets and Their Applications | Sendai, Japan |
| Sep 10-14, 00 | 2000 International Symposium on Formation, Physics, and Device Application of Quantum Dot Structures (QDS2000) | Hokkaido, Japan |
| Sep 10-15, 00 | The 11 th International Conference on Molecular Beam Epitaxy | Beijing, China |
| Sep 11-14, 00 | The 15 th International Acoustic Emission Symposium 2000 | Tokyo, Japan |
| Sep 13-15, 00 | The International Conference on the Physics and Application of Spin-Related Phenomena in Semiconductors | Sendai, Japan |
| Sep 17-22, 00 | 25 th International Conference on the Physics of Semiconductors (ICPS2000) | Osaka, Japan |
| Sep 18-20, 00 | The 6 th Asian Symposium on Information Displays and Exhibition | Xi'an, China |
| Sep 18-21, 00 | 8 th International Conference on Ferrites (ICF8) | Kyoto, Japan |
| Sep 24-27, 00 | The 9 th International Conference on Shallow-Level Centers in Semiconductors | Hyogo, Japan |
| Sep 24-28, 00 | Bulk Metallic Glasses Conference | Singapore |
| Sep 24-28, 00 | The 9 th International Conference on High Pressure Semiconductor Physics | Hokkaido, Japan |
| Sep 25-29, 00 | 14 th Int'l Conference on High Magnetic Fields in Semiconductor Physics | Shimane, Japan |
| Sep 25-29, 00 | 24 th International Congress on High Speed Photography and Photonics | Sendai, Japan |
| Sep 27-29, 00 | 9 th International Symposium on Semiconductor Manufacturing (ISSM2000) | Tokyo, Japan |
| Sep 27-29, 00 | IEEE International Workshop on Robot and Human Interaction (ROMAN2000) | Osaka, Japan |
| Oct 1-4, 00 | 6 th International Conference on Soft Computing (IIZUKA 2000) | Fukuoka, Japan |
| Oct 2-6, 00 | Solar-Terrestrial Energy Program-Results, Applications & Modeling Phase | Sapporo, Japan |
| Oct 11-14, 00 | 2000 International Forum on Biochip Technologies | Beijing, China |
| Oct 14-16, 00 | International Symposium on Superconductivity 2000 (ISS2000) | Tokyo, Japan |
| Oct 18-20, 00 | Advanced Metallization Conference 2000: Asian Session (ADMETA2000) | Tokyo, Japan |
| Oct 18-20, 00 | The 6 th Asian Symposium on Information Displays & Exhibition | Xian, China |
| Oct 19-21, 00 | International Symposium on Smart Structures and Microsystems 2000 | Hong Kong, China |
| Oct 22-25, 00 | International Symposium on Micromechatronics and Human Science | Nagoya, Japan |
| Oct 22-28, 00 | IEEE International Conference on Industrial Electronics, Control and Instrumentation (IECON-2000) | Nagoya, Japan |
| Oct 23-26, 00 | International Conference on Adaptive Structures and Technologies | Nagoya, Japan |
| Oct 25-27, 00 | The Third Asia-Pacific Conference on Simulated Evolution and Learning | Nagoya, Japan |
| Oct 30-Nov 2, 00 | Magneto-Optical Recording International Symposium and Asia-Pacific Data Storage Conference 2000 | Nagoya, Japan |
| Oct 30-Nov 5, 00 | International Conference on Intelligent Robots and Systems (IROS2000) | Kagawa, Japan |
| Nov 1-4, 00 | International Topical Symposium on Advanced Optical Manufacturing and Testing Technology | Chengdu, China |
| Nov 8-10, 00 | Optics and Optoelectronics China 2000 | Beijing, China |
| Nov 9-11, 00 | Techno Ocean 2000 | Kobe, Japan |
| Nov 13-17, 00 | 8 th Conference on Frontiers of Electron Microscopy in Materials Science | Matsue, Japan |
| Nov 14-18, 00 | 7th International Conference on Neural Information Processing (ICONIP 2000) | Taejon, Korea |
| Nov 15-17, 00 | 2 nd International Conference on Optical Design and Fabrication (ODF2000) | Tokyo, Japan |
| Nov 19-23, 00 | 7th IEEE Singapore Int'l Conference on Communication Systems (ICCS'00) | Singapore |
| Nov 20-23, 00 | 3 rd International Hydrology and Water Resources Symposium | Perth, Australia |
| Nov 27-Dec 2, 00 | International Symposium on Microelectronics and Assembly (ISMA2000) | Singapore |
| Nov 27-Dec 1, 00 | 4th Asia Pacific Conference on Computer Human Interaction (APCHI) 6th S.E. Asian Ergonomics Society Conference (ASEAN Ergonomics) | Singapore |
| Nov 28-30, 00 | IAPR Workshop on Machine Vision Applications (MVA2000) | Tokyo, Japan |
| Nov 29-Dec 1, 00 | 2nd International Conference on Experimental Mechanics | Singapore |
| Nov 30-Dec 2, 00 | International Symposium on Electronic Materials and Packaging 2000 | Hong Kong, China |
| Dec 3-6, 00 | Sustainable Energy and Environmental Technologies | Hong Kong, China |
| Dec 4-7, 00 | The 10 th International Workshop on Inorganic and Organic Electroluminescence | Hamamatsu, Japan |
| Dec 4-8, 00 | 2000 Contaminated Site Remediation Conference | Melbourne, Australia |

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| Dec 5-7, 00 | The 4 th International Conference on Nano-Molecular Electronics (ICNME2000) | Kobe, Japan |
| Dec 11-15, 00 | Australian Optical Society Conference Australian Institute of Physics Symposium | Adelaide, Australia |
| Dec 13-15, 00 | SPIE Smart Electronics and MEMS | Melbourne, Australia |
| Feb 5-9, 01 | Advanced Research Workshop on Semiconductor Nanostructures | Blenheim, New Zealand |
| May 6-9, 01 | International Light Materials Conference (LiMat 2001) | Pusan, Korea |
| May 14-18, 01 | Indium Phosphide and Related Materials, 2001 (IPRM'01) | Nara, Japan |
| Jul 1-5, 01 | Integrated Optics & Optical Communications Conference (IOOC) Opto-Electronics Communications Conference (OECC) Australian Conference on Optical Fibre Technology (AFOCT) | Darling Harbour Convention Centre, Sydney, Australia |
| Jul 1-6, 01 | 5th International Symposium on Advances in Polymers and Composites | Singapore |
| Jul 15-19, 01 | International Meeting of the Psychometric Society | Osaka, Japan |
| Jul 24-27, 01 | 2001 International Symposium on Signals, Systems, and Electronics | Tokyo, Japan |
| Jul 29-Aug 3, 01 | The 18 th International Conference on Crystal Growth (ICCG-13) | Kyoto, Japan |
| Oct 21-26, 01 | 8 th International Conference on Environmental Mutagens | Shizuoka, Japan |
| Nov 11-16, 01 | 9 th International Conference on the Conservation and Management of Lakes | Shiga, Japan |
| Jul 7-11, 03 | 5 th International Congress on Industrial and Applied Mathematics | Sydney, Australia |

Upcoming Window-on-Science Visitors

Contact us for more details if you are interested in the following WOS visitors.

| Dates | Visitor Name | Affiliation and Country | Topic | Visit Location |
|--------------|----------------------------|--|--|---|
| 23-24 May 00 | Prof. Hiroshi Hatta | Institute of Space and Astro Sciences, Japan | High Temp Oxidation Behavior of SiC-coated Carbon | AFRL/MLLM |
| 4-7 Jun 00 | Prof. Yohsuke Kamide | Nagoya University | Astronomy, Atmospherics, Geophysics | AFRL/VSBS |
| 4-7 Jun 00 | Dr. Leon Phillips | Univ of Canterbury, New Zealand | Astronomy, Chemistry, Physics | AFRL/VSBM |
| 9-10 Jun 00 | Prof. Kigook Song | Kyung Hee Univ., Korea | Reversible Photochromic Behaviors of Azobenzene Chromophore in Thin Film | AFRL/MLBP |
| 10-14 Jun 00 | Prof. John W. O'Byrne | University of Sydney, Australia | Optical Interferometry | AFRL/DEBS |
| 15-17 Jun 00 | Prof. Bumman Kim | Pohang University of S&T, Korea | Electronic Devices Millimeterwave Technology MMICs | AFRL/SNDI |
| 15-17 Jun 00 | Prof. Bongkoo Kang | Pohang University of S&T, Korea | Electronic Devices Millimeterwave Technology MMICs | AFRL/SNDI |
| 26-27 Jun 00 | Prof. Martin E.G. Helander | Nanyang Technology University, Singapore | Anthropometric Design of Workstations and Axiomatic Design | AFRL/HE |
| 1-31 Jul 00 | Dr. Ikai Lo | National Sun Yat-sen University, Taiwan | GaN Crystal Growth Techniques | AFRL/MLPO |
| 6 Jul 00 | Pro. Sung Ha | Hanyang University, Korea | Design of Flywheel Rotor | AFRL/VSDV |
| 16-18 Aug 00 | Prof. Wan Soo Huh | Soonsil University, Korea | Physical Properties of Polyolefin Blends | AFRL/MLBP |
| 20-23 Aug 00 | Prof. Greg Walker | Univ. of Tasmania, Australia | Boundary Layer Transition and Unsteady Aspects of Turbomachinery Flows | WOS in conjunction with Conference at Syracuse Univ, NY |
| 7-12 Sep 00 | Dr Paul Bates | Griffith University, Australia | Cooperative Research Center (CRC) and Human Factors Research | AFRL/HE |
| 14-16 Oct 00 | Prof. Chung-wen Lan | National Taiwan University | Bulk Crystal Growth, Computational Fluid Dynamics | AFRL/SNHX |

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